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A modelling toolkit to assist with introducing a stepped care system design in mental health care

Abstract

We describe a modelling toolkit that was developed with the aim of assisting those responsible for introducing stepped care systems to local mental health services in the UK. The toolkit was pre-populated with real patient flow data collected from four sites that piloted the stepped care system design. Two analytical models were developed and coded as part of the toolkit to provide insights concerning workload, patient throughput, and changes in waiting times and waiting list size. An interface was built to allow users to specify their own stepped care system and input their own estimates or data of service demands and capacities at different steps. Despite the challenges and limitations, the use of modelling to inform the design of new service configurations is an important step in the right direction and we would recommend this as a reasonable way forward.

Introduction

Primary mental health care in the UK has historically been troubled by long waiting times and, partly as a result, is currently undergoing a major reconfiguration. One of the aims of the reconfiguration is to improve access to evidence-based services for those suffering from common mental health problems such as depression and anxiety (National Institute for Clinical Excellence, 2009; National Institute for Health and Clinical Excellence, 2011; Pilling et al., 2011). The organisational model recommended by the National Institute for Clinical Excellence (NICE) to achieve this aim is the introduction of a stepped care system design (Bower and Gilbody, 2005a). Under this design, patients presenting with common mental health problems that cannot be successfully managed by their general practitioner (GP) may initially be offered some kind of low burden treatment – termed ‘low-intensity’ therapy (Bennett-Levy et al., 2010) – ahead of more intense forms of therapy if deemed necessary (Davison, 2000). The organisational changes required to adapt to this new service configuration are very challenging and potentially different for each local service (Bower and Gilbody, 2005b). Decisions concerning the size and skill-mix of the workforce, the number of appointments provided across the service, and the resultant impact of those decisions on patient access are key to a successful reconfiguration.

In this paper we describe a modelling toolkit that has been developed with the aim of assisting those responsible for introducing stepped care systems to local mental health services in the UK. The development of the toolkit was part of a multidisciplinary project for developing evidence based and acceptable stepped care systems in mental health care (Richards et al., 2010). The project involved assisting four study sites to develop and pilot their own implementations of the stepped care system design in the delivery of health services for common mental health problems (Richards et al., 2012). The knowledge and data generated with these pilot sites informed the parallel development of mathematical models of the key features of stepped care system design and the effects of taking different decisions in service planning. The toolkit was eventually populated with data generated by the pilot sites.

In the next section we describe in more detail the challenges involved in the introduction of stepped care in the UK. We then briefly describe the two mathematical models used in the toolkit before presenting in detail the inputs, outputs and functionality of the software. We conclude by discussing the limitations of the modelling toolkit and the challenges we faced in its development.

Introducing the stepped care system design in mental health care

The stepped care system design essentially entails offering or referring patients for treatment at different ‘steps’, with the intensity of treatment increasing at each step if they fail to benefit at previous steps (Richards et al., 2012). For patients presenting with common mental health problems and whose condition cannot be managed by their GP, the majority of them would be offered some form of low-intensity treatment first under the stepped care design. Those that do not improve are then referred on to higher intensity treatments (see Figure 1). Examples of low-intensity treatments for common mental health problems include group sessions, computer-based treatment and guided self-help, treatments which usually incorporate just a few support sessions with a para-professional mental health worker (Bennett-Levy et al., 2010). High-intensity treatments such as cognitive behaviour therapy, often the only alternative to GP care available in traditional service designs, usually take the form of several one-to-one treatment sessions between a professional mental health specialist and the patient and are spread over a number of weeks or months. The basic notion underpinning the drive to introduce stepped care to the organisation of health services for common mental health problems was that low-intensity treatments are both effective and less burdensome for many patients. Good access to low-intensity forms of treatment may reduce

the need for more expensive treatments for many, while increasing access to more effective forms of treatment for those that require it (Cuijpers et al., 2010).

[Insert Figure 1 near here]

Theoretically, stepped care models for common mental health problems could range along a continuum from purely stepped care systems at one end to stratified or matched systems at the other. In purely stepped care systems all patients receive a low-intensity treatment and only those who do not improve are ‘stepped up’ to high-intensity treatments. In stratified or matched systems patients are initially assessed and allocated to treatments of different intensity depending on factors identified during the assessment. Individual service configurations could include elements of both extremes whereby they include stratified patient exceptions to a general stepped model (e.g. by assessing and allocating to treatments patients with particular symptoms) or vice-versa.

Stepped care is one example of a complex intervention (Medical Research Council, 2008) defined as interventions that contain a number of component parts with the potential for interactions between them which, when applied to the intended target population, produce a range of possible and variable outcomes. Implementing complex interventions in routine practice presents additional challenges over and above those normally encountered when introducing new health care interventions and procedures. Information on the health technology or organisational system being implemented needs to be presented in a clear and easy to assimilate manner. Given that implementation will require those delivering the health service to change their behaviours, understanding these behaviours, the decision-making processes involved and the barriers to change is important and likely to lead to enhanced chances of success.

In this sense, the implementation of stepped care within an existing mental health service represents a major organisational challenge. A number of decisions need to be taken concerning the size and skill-mix of the workforce, the number of different treatments offered and the associated capacity levels and the protocol for how patients enter the service and move between treatments. Ideally, the scale and balance of provision between low and high-intensity treatments should avoid asymmetries in the service provision or bottlenecks impeding the progress of patients through the service and should reduce ‘wrong’ decisions, whereby patients are allocated to either low or high-intensity steps inappropriately.

To assist those responsible for the introduction of stepped care, a large scale study concerning its implementation was instigated by a multidisciplinary research team and funded by the National Institute for Health Research Service Development and Organisation Programme (Richards et al., 2010). The development of the software toolkit and the mathematical models reported here was a central part of this study. Knowledge and data generated from four pilot sites operating stepped care for a year informed the development of the mathematical models and empirical estimates were embedded into the software toolkit.

The toolkit was designed to provide estimates of system performance to service planners and to assist them in three ways:

- 1) to allow users to evaluate a range of potential service configurations in terms of expected demand for each treatment offered by the service, expected throughput and the estimated capacity required to meet the expected demand at each care step;
- 2) to provide users with the means to evaluate the impact of suggested changes on changes in waiting list size and waiting times over a projected period of six months;
- 3) to allow users to learn from the experience gained from the pilot sites by comparing their existing or planned service configurations with those of the pilot sites.

The mathematical models

The models needed to be simple as we could not assume that detailed information about future services would be either known or available. The models also needed to be flexible to allow for a large range of potential service configurations. We developed two mathematical models to be used in the software tool. They were designed to complement each other by providing the user with information on different aspects of their proposed stepped care system. Both models were based on the idea of a network of different treatments offered with patients moving between treatments. Here, only an overview will be given of the mathematical modelling with more detailed descriptions being the subject of separate technical publications.

Model to help estimate demand at each step

This first model is used to estimate the unconstrained demand for each service within a stepped care system and present this to the user as a fraction of the capacity allocated to that

service. By ‘unconstrained demand’ we refer to the demand for a service that would be experienced given a specified pattern of arrivals to the system if there were no capacity constraints. While to an extent unrealistic, this provides planners with useful information in the context of deciding how to allocate resources across a number of services.

The calculations performed for any service configuration involve calculating the mean arrivals to each treatment per unit time and multiplying this by the mean number of sessions utilised by an individual in that type of treatment to give the mean demand for appointments for that treatment per unit time. This is then divided by the number of sessions to be offered per unit time for that treatment to give an index reflecting the ratio of demand to supply. For example, if 10 patients are expected to arrive to a particular treatment per week and the mean number of sessions needed by an individual is two, then the expected (mean) weekly demand for appointments would be 20. If 18 sessions are offered on a weekly basis for that treatment then the ratio of demand to supply would be 111%.

For systems in which individuals can only visit a particular treatment once, the calculations are straightforward, even with due account being taken of the scope for there being multiple paths to a given treatment. For systems that contain cycles such that it is possible to visit a particular treatment more than once, the analysis is less straightforward. We took a pragmatic approach to estimating an ‘effective arrival rate’ based on restricting the patient flows incorporated in the model such that patients were assumed to perform a given cycle of treatments in the network at most once.

Model to help estimate throughput

The development of the second model was based on the observation that mental health care systems are often working at capacity with long waiting lists. If a unit of capacity is *always* ‘busy’, then its throughput depends only on how long the treatment takes. The key assumption here is that waiting list sizes never drop to zero and there is always at least one person waiting. Thus, by assuming that a mental health service is always ‘full’, we can model it as a network of units of capacity, each of which is always busy with throughput independent of others units. This greatly simplifies the mathematical treatment of the problem.

In the model, we chose a single diary slot as the basic unit of capacity. A patient is assumed to occupy the same diary slot every week until his or her treatment ends. Each diary slot is

associated with a particular type of activity (for instance a treatment type), which in turn is associated with a characteristic distribution of duration of treatment in terms of the number of diary appointments used. We assume that the treatment times of different patients are independent of one another and that a diary slot is allocated to just one type of treatment. By considering the distribution for duration of treatment of an individual patient, we can calculate the distribution of the number of people who have been treated in a particular diary slot over a given number of weeks. A more detailed description of this modelling approach can be found in (Pagel et al., 2012).

Toolkit implementation and usage

The design and implementation of the software toolkit was guided by the following requirements and envisaged use:

- the tool should be available to use at no direct cost to NHS organisations and should not require the availability of specialist software that is not commonly installed on personal computers;
- the tool should be designed for use as a planning tool by organisations at an early stage of the reconfiguration process, and as such it should permit users to construct and evaluate hypothetical services with a wide variety of structures and permissible patient flows;
- the tool should be predicated on the use of data generated at the pilot sites since intended users would not be expected to have relevant data pertaining to their own services.

Data are organised according to the data structure shown in Figure 2. User input is organised around scenarios. A scenario represents a network in terms of clinical activities offered and the flows of patients between them. Each scenario belongs to a particular site and each site may have multiple scenarios. Each network comprises a number of clinical activities (or treatments) and end points, the latter representing patient outcomes (e.g. completion of treatment, discontinuation etc.). Each clinical activity is of a certain type (referral, assessment, individual treatment or class) and has a probability distribution of duration through a linked analogous pilot site activity.

[Insert Figure 2 near here]

The user interface of the toolkit was implemented in MS Excel 2003 with extensive use of Visual Basic for Application (VBA) routines. Both mathematical models were coded using VBA routines. All data used or generated by the tool are stored within a custom-designed relational database in MS Access 2003 to facilitate their quick retrieval and manipulation and appropriate data management. Routines were included in the VBA code so that the data exchange between Excel and Access is seamless and not apparent to the user.

User interface

The user interface comprises a combination of Excel worksheets and forms to accept input and display output. The main input parameters are entered by the user using two worksheets. The first worksheet, called 'Interface', is divided into four areas (see Figure 3). Information about the particular site and scenario currently being viewed is displayed in the area at the top left corner. The buttons for creating, saving, viewing and evaluating scenarios are contained in the top right corner. There is also a "Help" button with shortcuts to most of the user actions and a "Start again" button. A set of steps for creating a scenario is displayed in the bottom right corner. In the bottom left corner the user creates, updates or views the service configuration of each scenario. There is also a button that takes the user to a calculator for determining the number of appointments offered each week based on the number of professional full-time equivalent staff available. A wizard is available that takes the user through the steps required for creating a new scenario.

[Insert Figure 3 near here]

As explained previously, a scenario comprises a user-defined number of clinical activities and end points (outcomes) and the flows between them. A clinical activity can be one of following types: referral, assessment, individual treatment or class. Each clinical activity is matched by the user to one of a choice of analogous pilot site activities that the tool comes pre-populated with and are made available to the user via a pop-up window (see Figure 4, part A). The analogous pilot site activity determines the duration of the treatment distribution, in terms of number of sessions, and the unscheduled completion (or discontinuation) rate from the corresponding pilot site data. Although the median duration of treatment is displayed in the pop-up window, the entire frequency distribution can also be viewed if desired (Figure 4, part B). Finally, the user is asked to provide estimates of new referrals per week from outside the service, the number of individual appointments or classes offered per

week, as well as the course length and maximum class size in the case of class or group-based clinical activities.

[Insert Figure 4 near here]

The second worksheet, called ‘Patient Movement’, is used for entering the proportion of patients leaving one activity that go to each other activity or end point (see Figure 5). Data input is facilitated through a table that has clinical activities in the rows and clinical activities and end points in the columns. Row and column headings are populated by the tool based on the data entered by the user in the previous worksheet. The last column is called ‘Remaining’ and shows the sum of each row, helping the user to fill in the proportions of patients flowing out of each clinical activity.

All proportions are user-defined apart from unscheduled completions (patients that do not attend or withdraw early) which are taken from the analogous pilot site data associated with each activity. These unscheduled completion rates cannot be changed as they are intrinsically linked to the activity duration distributions and any changes would result in misleading estimates of demand and throughput. There is also a tendency for planners to underestimate the proportion of patients that withdraw or do not attend when planning a new service. Once the patient movement data are entered and saved, the user can generate a series of graphical flowcharts of patient pathways to help visualise and validate the entire service configuration (button “Flowcharts” in Figure 4).

[Insert Figure 5 near here]

Toolkit output

Model output is provided based on the two mathematical models described previously, using a combination of the data entered by the user and the relevant pilot site data. The results of each model are presented in a different output displays. In each display, quantities that are estimated from the relevant model are rounded to the nearest five in an effort to avoid over-interpretation of what are essentially broad estimates of system performance.

In the ‘Planning Summary’ display (Figure 6, part A) the output is generated using the model that estimates demand. It provides the user with estimates of the expected weekly demand for appointments for each clinical activity (3rd column), the ratio of demand to appointments

offered (4th column) and a range for the suggested number of appointments (last column). A message informing the user of a mismatch between demand and supply appears when the ratio of demand to appointments offered exceeds 120%.

[Insert Figure 6 near here]

In the 'Summary of system performance over a 6 month period' display (Figure 6, part B) the output is generated by the throughput estimation model and includes the estimated throughput for all clinical activities and end points. For each clinical activity, the output also displays an estimate of the expected change in waiting list size and waiting times over 6 months. A range for the estimate is given where appropriate (+/- one standard deviation). As this particular mathematical model is based on the assumption that the care system is always full, a message informing the user of potential overestimation of activity and throughput is displayed whenever the lower bound on the estimated increase in waiting list size is zero or negative.

Illustrative example of use

In the example shown in Figures 3-6, the particular service configuration comprises three clinical activities (assessment, low-intensity treatment, high-intensity treatment) and two end points (unscheduled completion and completion). Each clinical activity is paired with analogous activities from the third pilot site which provide the treatment duration distributions and the unscheduled completions proportions.

All referrals from external sources such as from general practitioners are to assessment (12 new referrals per week). On average, half of the patients assessed are expected to be referred on for low-intensity treatment while one in 10 are referred for high-intensity treatment (Figure 5). Finally, 32% of patients are expected to discontinue their contact with the service at this stage (Unscheduled completion) and the remaining 8% are expected to not require a referral to another clinical activity. From those patients referred to low-intensity treatment, one in 5 require further high-intensity treatment, while almost half (47%) complete their treatment as planned and one in three (33%) discontinue. A similar proportion of patients discontinue their high-intensity treatment (34%) while the remaining 66% complete as scheduled.

As illustrated in the screenshots, the capacity, in terms of weekly appointment slots offered, has been set below the level of expected demand for appointments (Figure 6, columns 3 and

5). Thus the ratio of demand to appointments for each clinical activity is greater than 100% and the expected increases in waiting list size and times for assessment are high (see also Table 1, Scenario 0). Increasing the number of appointments offered while keeping all other parameters the same, reduces, as expected, the ratio of demand to appointments offered and the expected increases to waiting list size and times, while increasing the expected throughput (see scenarios 1 and 2 in Table 1). A further hypothesis is tested in Scenario 3 whereby the proportion of patients referred on from low intensity to high-intensity treatment is reduced from 20% to 10%. This hypothetical change in low-intensity treatment outcomes would allow managers to offer a reduced weekly number of high intensity appointments (down to 10 from 15 offered in Scenario 2) , as such a reduction would yield a lower estimated ratio of demand to appointments offered (86%) despite moderate estimated increases in waiting list size (0 to 15 patients) and times (0 to 5 weeks over the 26 week period considered).

[Insert Table 1 near here]

Toolkit evaluation

We used a qualitative design to investigate the use of the stepped care reconfiguration tool and accompanying manual across various NHS primary care sites in England. Users of the tool were from a range of positions within the NHS, including service managers, clinical leads and business managers. We initially distributed the tool to 11 sites that were in the process of introducing stepped care and had agreed to evaluate an early version of the tool. As was intended in the overall design of the entire study, all 11 sites received very little support apart from a comprehensive manual and an installation CD-ROM with the tool. After a period of time, those sites were contacted and we collected qualitative data on tool usage using semi-structured interviews and a focus group. The data were then analysed using framework analysis (Miles and Huberman, 1994). Table 2 presents a summary of themes and subthemes that emerged from the analysis. Full results of the qualitative evaluation of the toolkit can be found elsewhere (Richards et al., 2010).

A number of factors were involved in using the tool and manual including change, and within this the pace and timing of change, technical and personal factors. Change was a big factor in staff members use of the tool. Implementation of the Improving Access to Psychological Therapies (IAPT) national programme, which entailed the setting up of new services with local managers employing new staff and designing new patients pathways to a rigidly

prescriptive model (Richards and Suckling, 2009), was happening at the same time that they were trying to use the tool and this had various implications. The significant service restructuring that IAPT required meant that when staff members received the tool, the service they were trying to model had often not finished being modified. The pace and timing of change was very fast and this meant increased workload and other priorities for managers with decisions being made pragmatically rather than with a tool. A tool that was intended for use as a planning aid, got taken over by change and meant that staff were too far through the change process to use it to its full potential.

Technically some users found the tool simple and easy to use. Some felt that visually it could have been less complicated, especially the patient movement part of the tool. The manual was seen as easy to use and very informative with useful screenshots. Staff members had problems finding pilot sites' data to match their own, however, the tool was not designed to be used with sites who were so data savvy. Many of the technical aspects were addressed in response to this feedback in an upgraded version of the toolkit, which should make the tool easier to use.

Personal factors affected staff members use of the tool including pressures on time and workload. Many staff did not have the capacity to use the tool and some felt they would like to see proven benefits of the tool before they committed time and energy to it. Lastly, staff members felt that they would have benefited, and may have used the tool to its full potential, if there had been some more support, for instance over the telephone or in the form of a workshop.

Discussion

This paper has described the development of analytical methods and a toolkit to assist the process of reconfiguring mental health care services. We have described the development of a modelling toolkit incorporating two analytical models and accompanied by a comprehensive manual for managers and service leaders to use when planning their own stepped care services.

For clarity we presented the final version of the modelling toolkit. However, the development of the toolkit took place through an iterative process and feedback was solicited from end users throughout the development lifecycle. Many of the features included in the final version were the result of this process. We also provided a comprehensive manual with examples of

usage from the four pilot sites, incorporated data into the toolkit from the pilot sites and implemented user friendly features such as a wizard for creating new scenarios and an on-line help. There is no escaping however that, besides those four sites piloting the models and toolkit, the additional 11 sites that were used in the evaluation by and large missed out on the learning opportunity arising from the modelling process itself.

The choice of using analytical methods as opposed to simulation was partly dictated by the requirement of having a toolkit distributed to a large number of mental health services, which would not have access to specialised software. While not generating the ‘best’ possible configuration of services, the toolkit can be used in a ‘what-if’ fashion in order to filter through many possible service configurations and help to identify those that are unlikely to be effective. At the same time, given the envisaged usage of the toolkit (to assist planners at an early stage of the reconfiguration process) and the anticipated lack of relevant data in non-pilot sites, simpler data based approaches such as, for example, the monitoring of existing waiting lists would not have been viable. For the same reasons, we decided not to include scope for users to enter their own durations of treatment but to provide the option of selecting from a pre-populated set of distributions as they were observed in the pilot sites.

The challenges associated with developing generic tools and the interfaces of models have been recognised before (Fletcher and Worthington, 2009). A further challenge in this particular project was posed by the fact that the toolkit had to be distributed to sites without additional support or adjuvant consultancy. We attempted to address this challenge by keeping the analytical models simple and by designing the user interface in such a way to allow a wide range of service configurations to be defined. By using simple models we also managed to keep the toolkit generic and flexible to allow for a large range of different service configurations.

A further limiting factor was the lack of clinical outcome or cost data and hence the focus of the modelling on administrative rather than clinical outcomes or cost considerations. Even then, it soon became clear that basic activity data upon which to base service reconfiguration planning were not readily available, nor were such data routinely recorded in a uniform fashion that would allow their extraction from historic records. In view of this, the typical OR process - starting with a simple process model followed by repeated prototyping to add increasing sophistication in the light of experience - was somewhat reversed. Instead, the development process involved honing down and discarding sophistication with the aim of

producing analytical methods sufficiently simple that they could be used given the paucity of planning data typically available.

Conclusion

We developed a modelling toolkit accompanied by a comprehensive manual for managers and service leaders to use when planning their own stepped care services that appears to have been of some assistance, particularly to the pilot sites that worked closely with the analytical team. While not generating the ‘best’ possible configuration of services, it can be used in a ‘what-if’ fashion in order to filter through many possible service configurations and help to identify those that are unlikely to be effective. Despite the challenges and limitations, the use of modelling to inform the design of new service configurations is an important step in the right direction and we would recommend this as a reasonable way forward. Additional training, technical support and perhaps adjuvant consultancy would most likely need to be made available to new users to increase chances of frequent and effective use.

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References

Bennett-Levy J, Richards D, and Farrand P (2010). Low intensity CBT interventions: a revolution in mental health care. In: Bennett-Levy J, Richards D, Farrand P, Christensen H, Griffiths K, & Kavanagh D (Eds). *Oxford guide to low intensity CBT interventions*. Oxford University Press: Oxford.

Bower P and Gilbody S (2005a). Managing common mental health disorders in primary care: conceptual models and evidence base. *British Medical Journal* **330**: 839-842.

Bower P and Gilbody S (2005b). Stepped care in psychological therapies: access, effectiveness and efficiency. Narrative literature review. *British Journal of Psychiatry* **186**: 11-17.

Cuijpers P, Donker T, van S A, Li J, and Andersson G (2010). Is guided self-help as effective as face-to-face psychotherapy for depression and anxiety disorders? A systematic review and meta-analysis of comparative outcome studies. *Psychological Medicine* **40**: 1943-1957.

Davison G C (2000). Stepped care: doing more with less? *Journal of Consulting and Clinical Psychology* **68**: 580-585.

Fletcher A and Worthington D (2009). What is a 'generic' hospital model? A comparison of 'generic' and 'specific' hospital models of emergency patient flows. *Health Care Management Science* **12**: 374-391.

Medical Research Council (2008). *Developing and evaluating complex interventions: new guidance*. MRC: London.

Miles M B and Huberman A M (1994). *Qualitative data analysis: An expanded sourcebook*. Sage Publications: London.

National Institute for Clinical Excellence (2009). *Depression: Management of depression in primary and secondary care*. NICE: London.

National Institute for Health and Clinical Excellence (2011). *Generalised anxiety disorder and panic disorder (with or without agoraphobia) in adults. Management in primary, secondary and community care*. NICE: London.

Pagel C, Richards D, and Utley M (2012). A mathematical modelling approach for systems where the servers are almost always busy. *Computational and Mathematical Methods in Medicine* **ID:290360, doi:10.1155/2012/290360**.

Pilling S, Whittington C, Taylor C, and Kendrick T (2011). Identification and care pathways for common mental health disorders: summary of NICE guidance. *British Medical Journal* **342**: d2868.

Richards D and Suckling R (2009). Improving access to psychological therapies: phase IV prospective cohort study. *British Journal of Clinical Psychology* **48**: 377-396.

Richards, D., Weaver, A., Utley, M., Bower, P., Cape, J., Gallivan, S. et al. (2010). *Developing evidence based and acceptable stepped care systems in mental health care: an operational research project. Final report.* NIHR Service Delivery and Organisation programme: London.

Richards D A, Bower P, Pagel C, Weaver A, Utley M, Cape J, Pilling S, Lovell K, Gilbody S, Leibowitz J, Owens L, Paxton R, Hennessy S, Simpson A, Gallivan S, Tomson D, and Vasilakis C (2012). Delivering stepped care: an analysis of implementation in routine practice. *Implementation Science* **7**: 3.

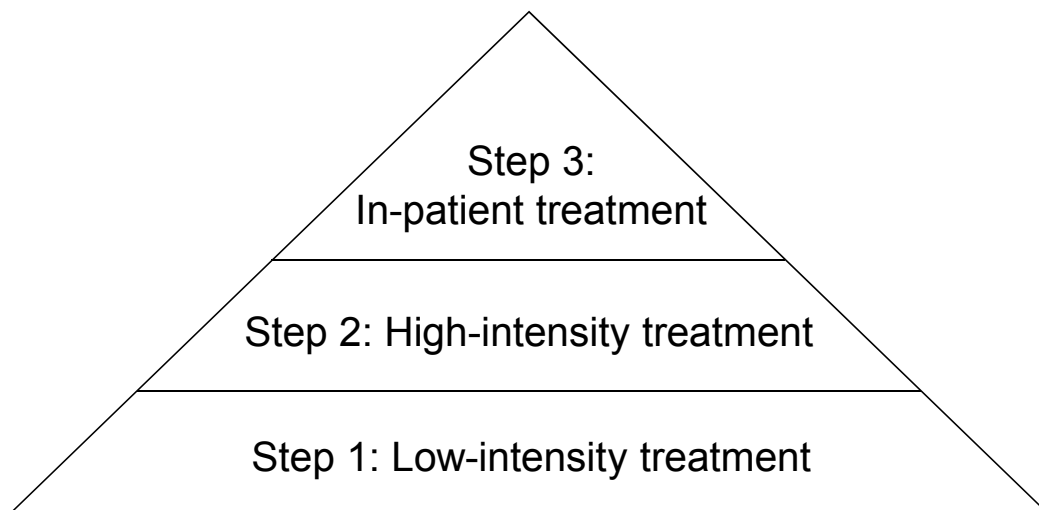


Figure 1.

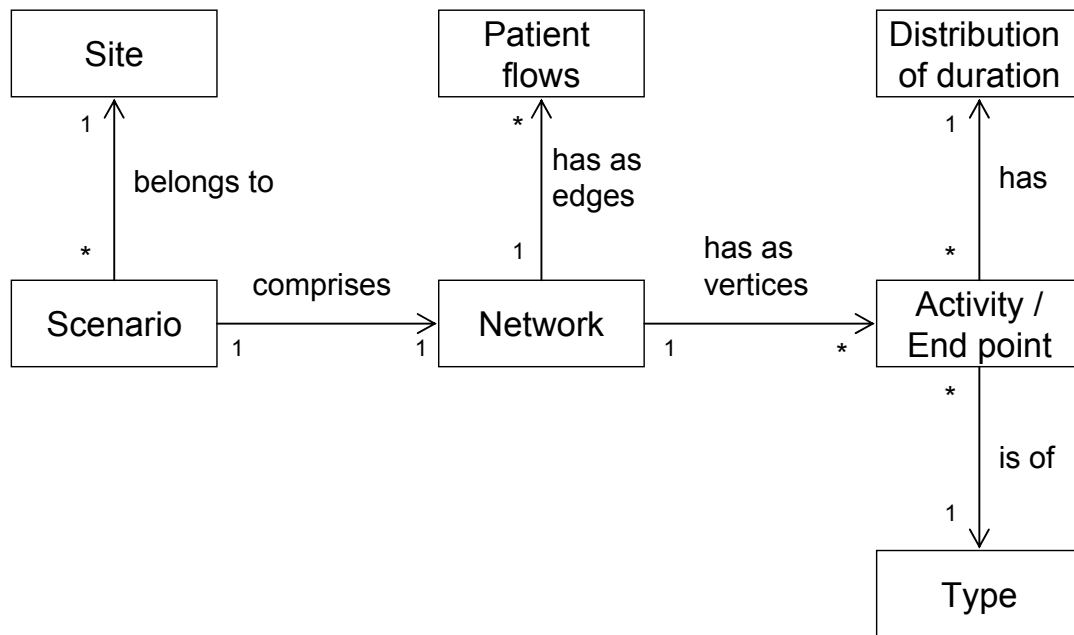


Figure 2.

Microsoft Excel - ReconfigTool16

File Edit View Insert Format Tools Data Window Help Adobe PDF

100%

Arial 10

C1 100

1	Site ID	100
2	Site name	Examples
3	Scenario ID	99
4	Scenario name	Test scenario
5	Date created	03/09/2010
6	Last date modified	03/09/2010
7	Weeks to run model for	26

Manage Scenarios Start again Save Scenario

Evaluate resource use Evaluate throughput

Help Patient movement Flowcharts

Activities										
ID	Clinical activity or End point name	ADD DEL	Type	Analogous pilot site activity	New referrals per week	Appointments available per week	Course length (weeks)	Max class size		
1	Assesment		ASM	Assessment	PS3,1	Pilot 3, Initial assessment	12	12	0	1
2	Low int treatment		TRE	Indv treatment	PS3,2	Pilot 3, Low intensity	0	20	0	1
3	High int treatment		TRE	Indv treatment	PS3,3	Pilot 3, High Intensity (Pri	0	10	0	1
90	Unscheduled completion		ENP	End point						
91	Completion		ENP	End point						

Apt.calculator

When building a new scenario, we suggest you follow these steps:

- click on 'Manage Scenarios' and then 'New scenario', enter identifying details for your scenario and click 'Save'
- once you have selected the scenario, fill in the clinical activity and end point names, while choosing the type and analogous pilot site activity as you go
- enter the number of appointments per week, and course length & class size for any classes
- enter the new referrals per week to activities that have any
- click on the Patient movement button to either import patient movement data from the selected pilot sites or manually add/modify them
- use the Flowcharts button to check your scenario visually
- evaluate resource use and throughput by clicking the respective buttons
- find helpful shortcut button to most of the functions by clicking on the Help button

Interface

Figure 3.

A

Select an analogous pilot site activity from the list

Pilot site	Activity name	Unscheduled completion rate	Median activity duration (sessions)
<input type="radio"/> Pilot site 1	Referral	20%	0
<input type="radio"/>	Initial assessment	21%	1
<input type="radio"/>	Low intensity	46%	2
<input type="radio"/>	Secondary assessment	20%	1
<input type="radio"/>	High Intensity (Primary Care)	30%	4
<input type="radio"/>	High Intensity (Sec/ry Care)	44%	4
<input type="radio"/> Pilot site 2	Initial assessment	8%	1
<input type="radio"/>	Low intensity	34%	3
<input type="radio"/>	Stress class	30%	0
<input type="radio"/>	High Intensity (Primary Care)	22%	4
<input type="radio"/>	High Intensity (Sec/ry Care)	31%	2
<input type="radio"/> Pilot site 3	Initial assessment	32%	1
<input type="radio"/>	Low intensity	33%	3
<input checked="" type="radio"/>	High Intensity (Primary Care)	34%	2
<input type="radio"/> Pilot site 4	Referral	43%	0
<input type="radio"/>	Assessment for low intensity	25%	1
<input type="radio"/>	Guided self help	32%	1
<input type="radio"/>	Community links	30%	1
<input type="radio"/>	CCBT	23%	7
<input type="radio"/>	Both GSH & CL	30%	2
<input type="radio"/>	Referral to high intensity primary care psychology	3%	0
<input type="radio"/>	High intensity primary care psychology assessment	33%	1
<input type="radio"/>	High intensity primary care psychology individual treatment	34%	5
<input type="radio"/> IAPT sites	Doncaster Assessment	13%	1
<input type="radio"/>	Doncaster Low Intensity Treatment	25%	3
<input type="radio"/>	Newham High Intensity Treatment	35%	9

Select Close Duration Pilot sites

B

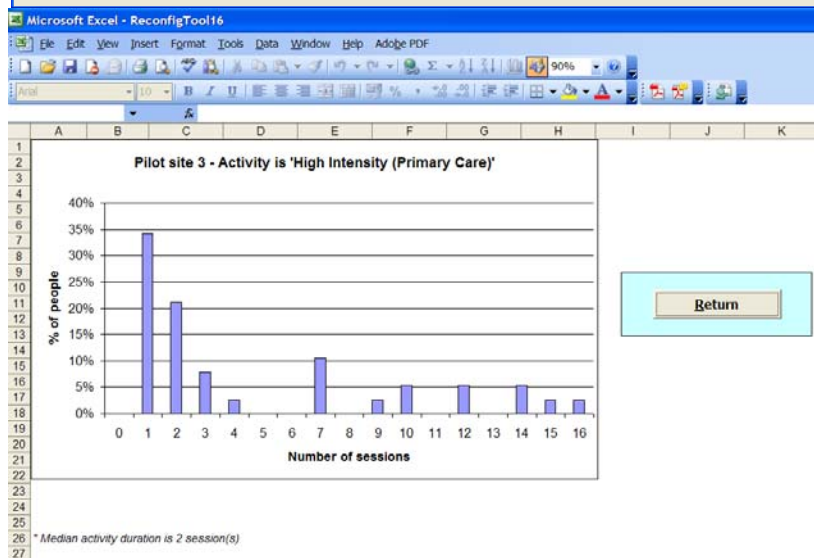


Figure 4.

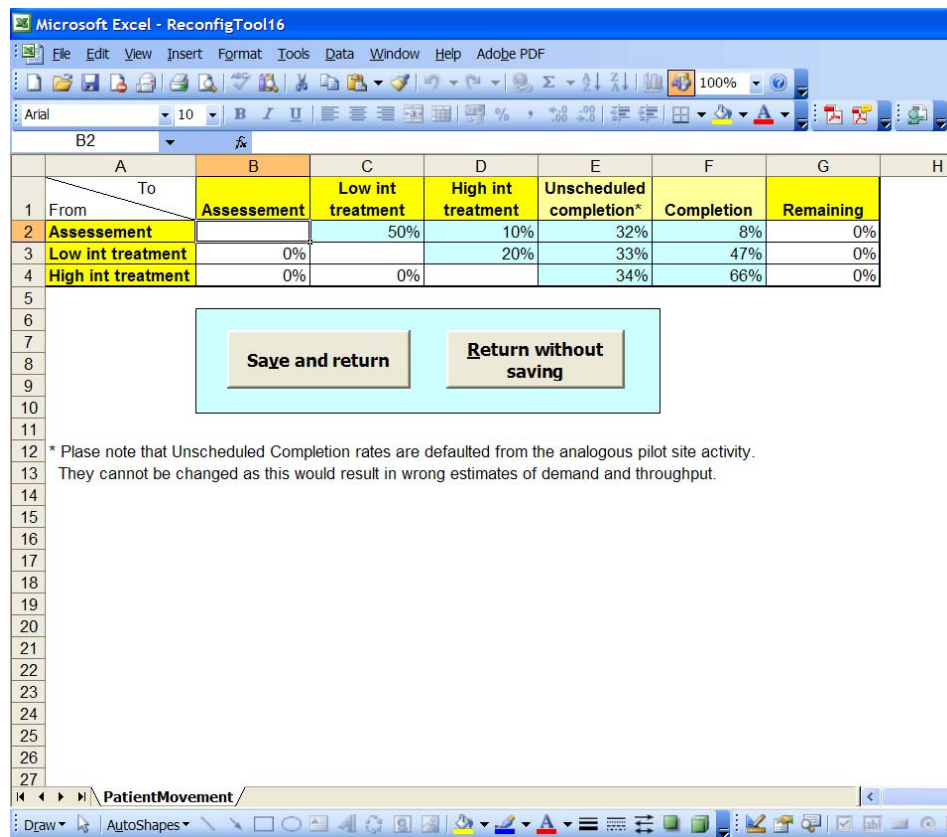
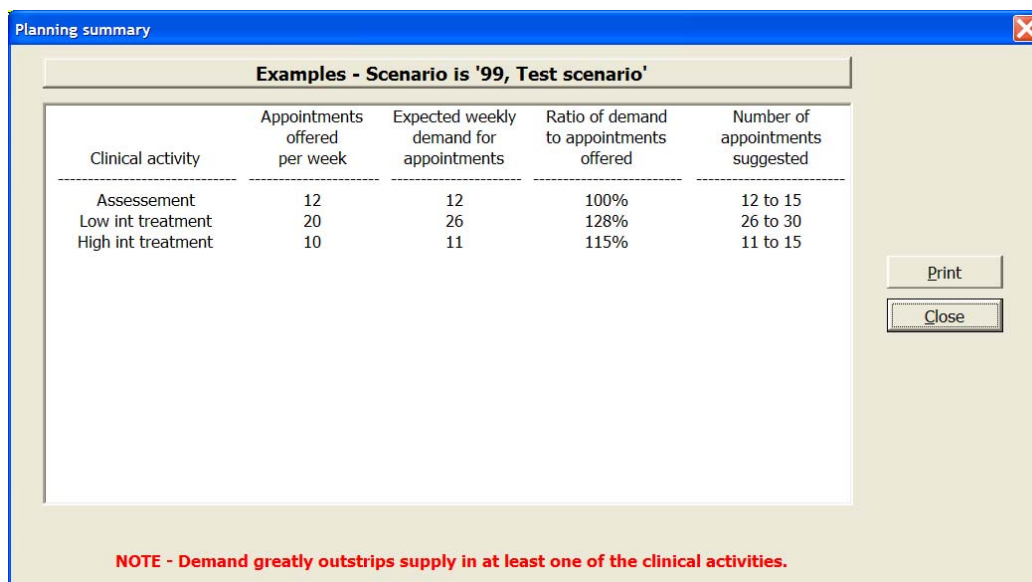
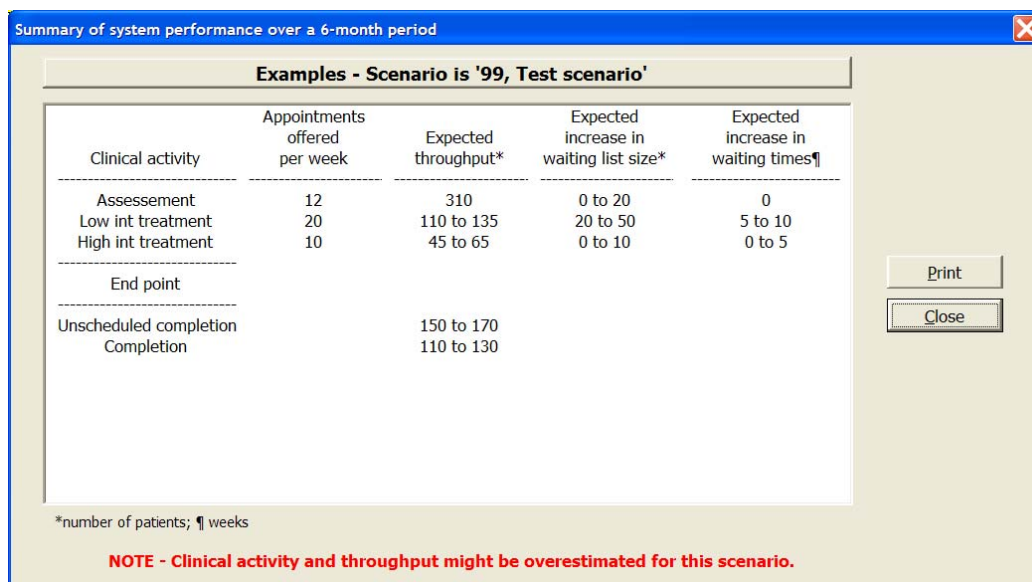


Figure 5.



A



B

Figure 6.

Clinical activity / end point	Appointments offered per week	Ratio of demand to appointments offered	Expected throughput*	Expected increase in waiting list size*	Expected increase in waiting times¶
Scenario 0					
Assessment	10	120%	260	35 to 70	5
Low int. treatment	20	128%	110 to 135	0 to 20	0 to 5
High int. treatment	10	115%	45 to 65	0 to 5	0
Unscheduled compl.			130 to 155		
Completion			105 to 125		
Scenario 1 (increase in appointments offered)					
Assessment	12	100%	310	0 to 20	0
Low int. treatment	26	98%	145 to 170	0 to 15	0
High int. treatment	11	104%	55 to 70	0 to 15	0 to 5
Unscheduled compl.			160 to 185		
Completion			130 to 150		
Scenario 2 (further increase in appointments offered)					
Assessment	15	80%	390	0	0
Low int. treatment	30	85%	170 to 195	0 to 30	0 to 5
High int. treatment	15	77%	75 to 90	0 to 5	0
Unscheduled compl.			200 to 225		
Completion			160 to 185		
Scenario 3 (10% of patients referred from low to high intensity treatment instead of 20%)					
Assessment	15	80%	390	0	0
Low int. treatment	30	85%	170 to 195	0 to 30	0 to 5
High int. treatment	10	86%	45 to 65	0 to 15	0 to 5
Unscheduled compl.			190 to 215		
Completion			160 to 185		

* number of patients; ¶ weeks.

Table 1.

Themes and sub-themes	
Change	
	<i>Prescriptive nature of change</i>
	<i>Pace and timing of change</i>
	<i>Using the tool to facilitate change</i>
Technical factors	
	<i>Visual</i>
	<i>Patient movement</i>
	<i>Pilot sites / Tool based on data</i>
	<i>Concurrent activities</i>
	<i>Manual</i>
Personal factors	
	<i>Workload / Capacity</i>
	<i>Benefits vs costs</i>
	<i>Lack of support / training</i>

Table 2.

Figure captions and table headings

Figure 1. Simplified stepped care model for patients with common mental health problems.

Figure 2. Conceptual data structure of the database underlying the software tool. All relationships are one-to-many meaning that each record in table A may have many linked records in table B but each record in table B may have only one corresponding record in table A. The many side of the relationship is represented by ‘*’. For example, each activity or end point can be of only one particular type, but there may be more than one activities of the same type.

Figure 3. ‘Interface’ worksheet allowing user to specify the clinical activities of a scenario and associated new referrals and capacity.

Figure 4. The user is asked to match each local activity to an analogous pilot site one (part A). The unscheduled completion rate as well the median activity duration as calculated in each pilot site are also displayed. The user can also view the entire duration distribution in graphical format (part B).

Figure 5. ‘Patient Movement’ worksheet allowing the user to specify the proportions of patients moving between activities and from activities to end points.

Figure 6. The ‘Planning summary’ output (part A) and ‘Summary of system performance over a 6-month period’ output (part B) forms.

Table 1. The effect of different levels of capacity, in terms of number of appointment offered per week, on patient throughput and changes in waiting list size and waiting times.

Table 2. Summary of themes and sub-themes arising through the qualitative evaluation of the toolkit.